

# **Eradication revisited: dealing with exotic species**

Judith H. Myers, Daniel Simberloff, Armand M. Kuris and James R. Carey

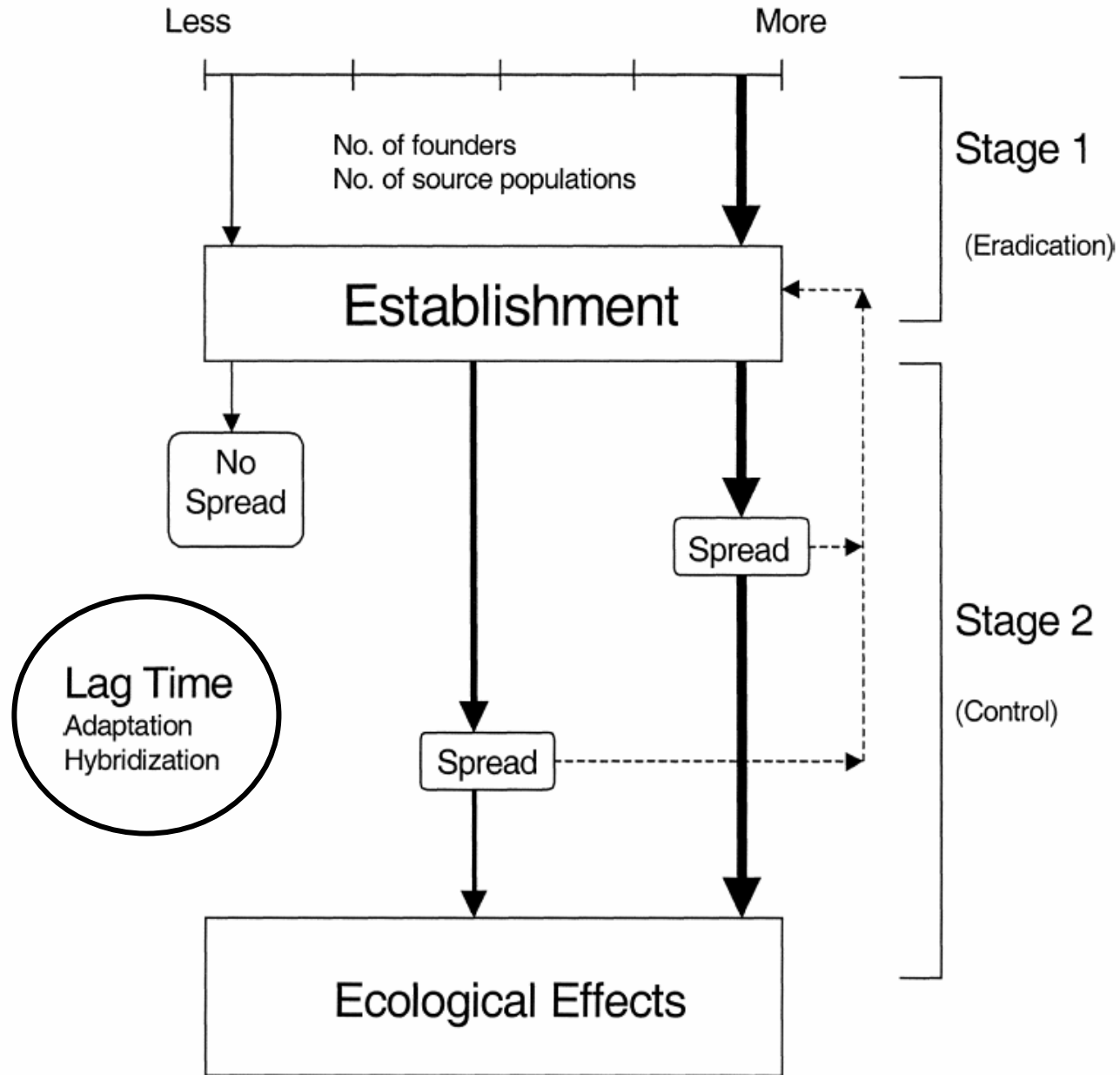
Invasion by NONINDIGENOUS species is recognized as second only to loss of habitat and landscape fragmentation as a major cause of loss of global biodiversity. The economic impact of these species is a major concern throughout the world. Management and control of nonindigenous species is perhaps the biggest challenge that conservation biologists will face in the next few decades.

# **Introduction: Population Biology, Evolution, and Control of Invasive Species**



**Fig. 1.** The first attempts to eradicate the gypsy moth (*Lymantria dispar*) occurred in Massachusetts in the late 1800s and involved manually removing egg masses. Populations initially declined but underwent a resurgence ten years later<sup>30</sup>.

# Propagule Pressure



Two paradoxes emerge from the comparison of our understanding of genetics in the conservation of species and the invasion of introduced species:

*(1) If population bottlenecks are harmful, then why are invasive species that have gone through a founding bottleneck so successful?*

*(2) If local adaptation is common and important, then why are introduced species so successful at outcompeting and replacing native species?*

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Lewontin: I would like to be a spokesman for the geneticists and clear up the confusion that I think we've spread about the effect of small numbers in colonizations. If there is colonization by a single fertilized female, there will be a loss of genes and a radical change in gene frequencies at loci where alleles are at intermediate frequencies. But the one thing that will not happen is a profound change in the total amount of genetic variation available.

Mayr: But isn't that based on certain assumptions? Suppose you had a thousand loci each with 25 isoalleles, are you still telling us that you get 75% of that variation in that one single pregnant female?

Many invasive species actually have more genetic variation in their introduced range because of introductions from multiple genetic divergent populations.

Also, many invasive species are hybrids between subspecies or species (e.g., tamarisk).

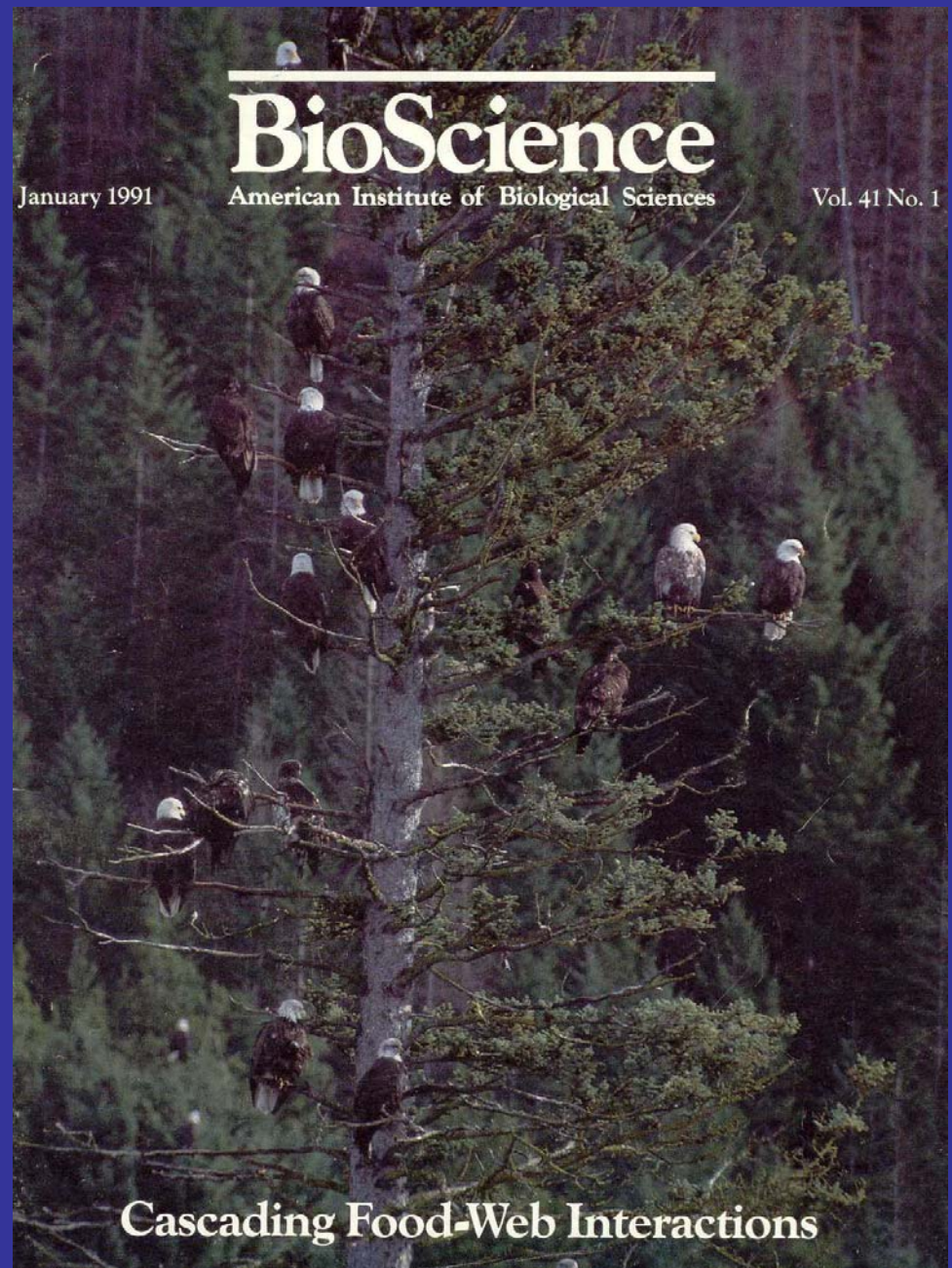
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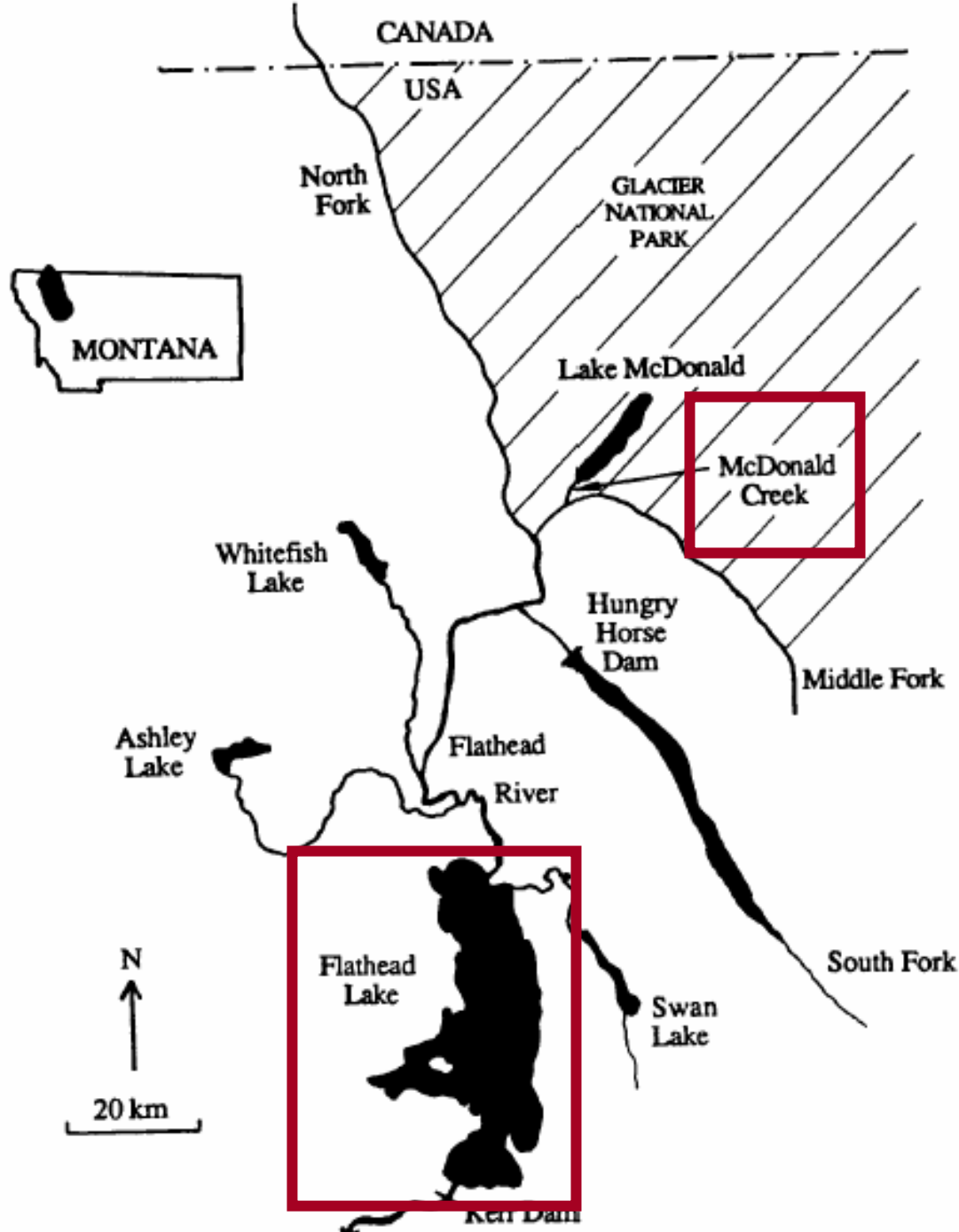
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Short-term  
versus  
Long-term  
Adaptation





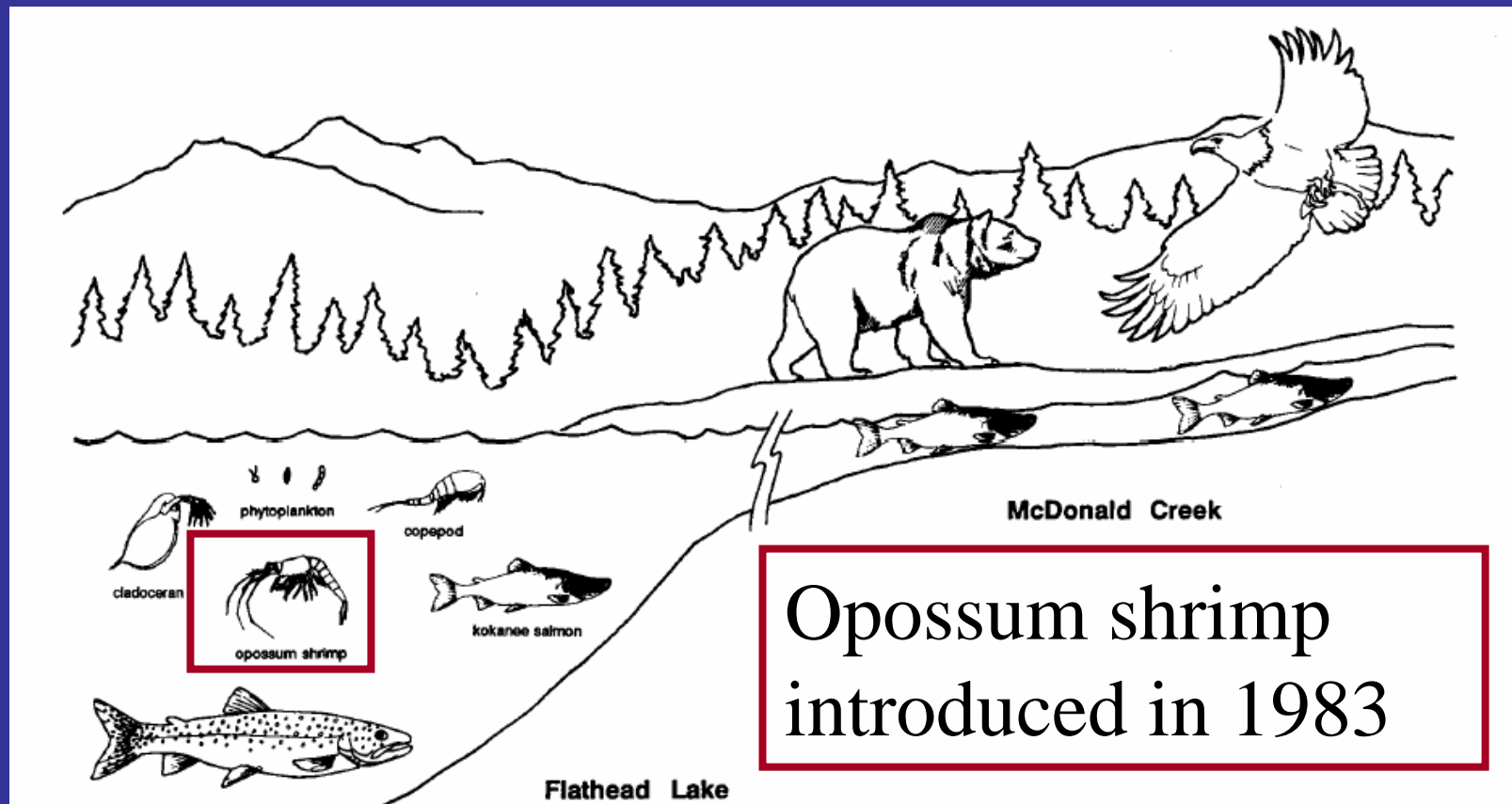
Kokanee  
salmon  
introduced into  
Flathead Lake  
in 1910.

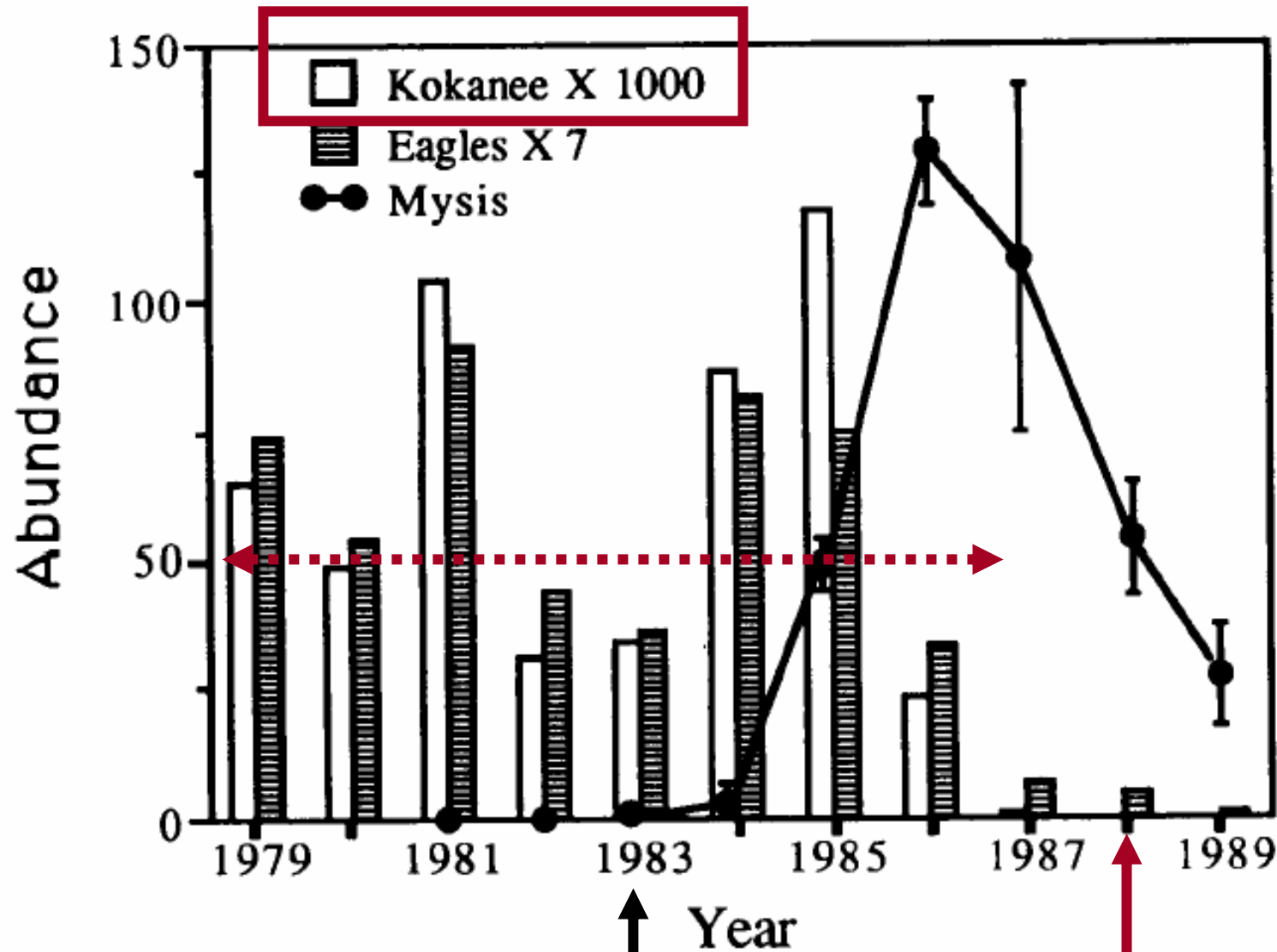


# Shrimp Stocking, Salmon Collapse, and Eagle Displacement

*Cascading interactions in the food web of a large  
aquatic ecosystem*

Craig N. Spencer, B. Riley McClelland, and Jack A. Stanford





Shrimp introduced

Kokanee  
Extinction



# RAPID EXTINCTION!

Observation: Extinction of large population (over 100,000 annual spawners) with many subpopulations (~10) within 5 years after introduction of opossum shrimp (*Mysis relicta*).

Conclusion: Even very successful introduced populations are more susceptible to environmental changes than native populations which have persisted for thousands of years.

Episodic selection: local adaptations essential during periodic episodes of extreme environmental conditions (e.g., winter storms, drought, or fire).

*Populations may experience “ecological crunches” in variable climates, nullifying the assumptions of competition theory and limiting the usefulness of short-term studies of population patterns*

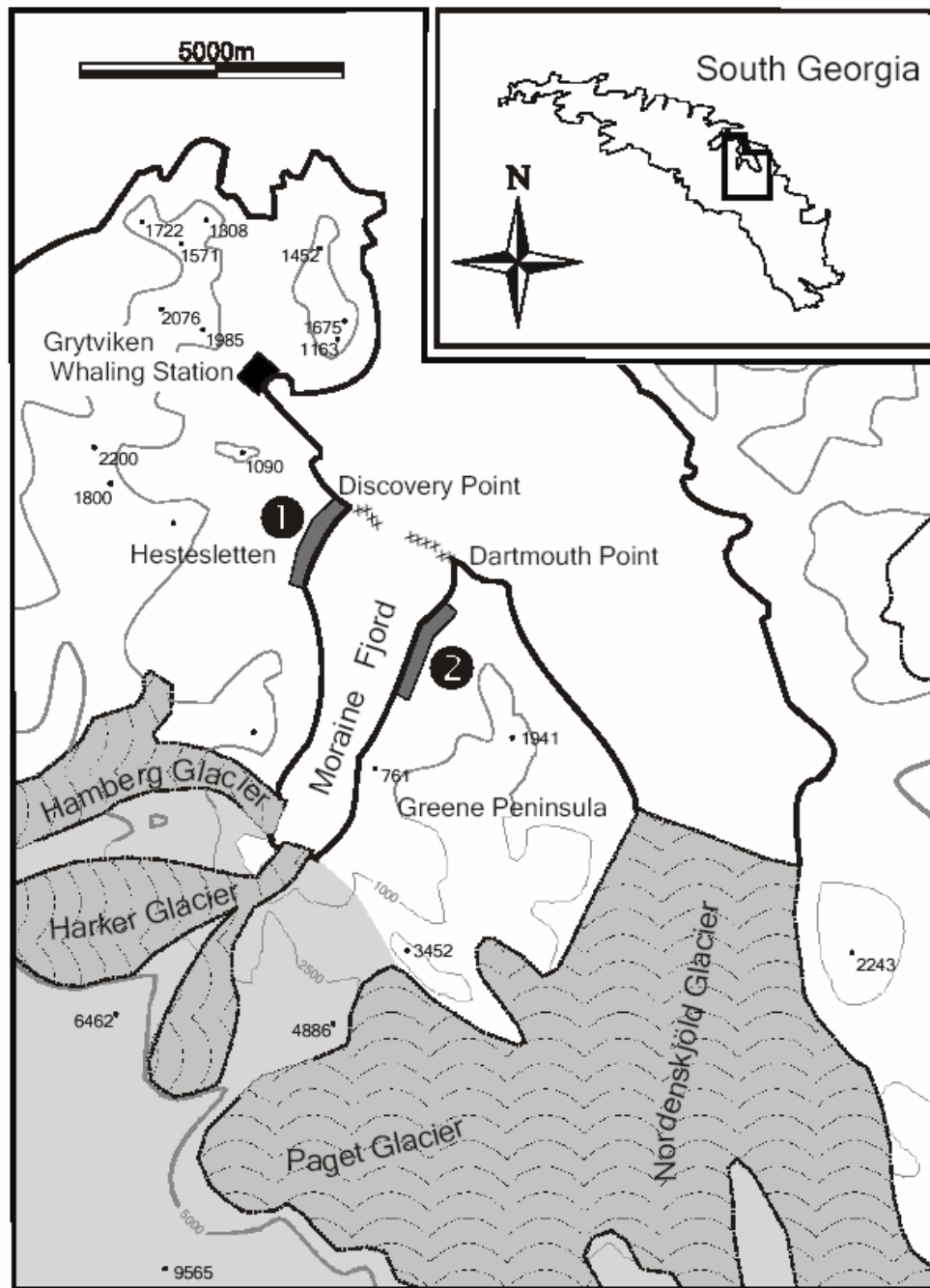
Native species are adapted to the long-term. There are likely trade-offs between long-term and short-term adaptations.

# Units of Eradication

Defining eradication units: Introduced brown rats *Rattus norvegicus* on  
South Georgia, Southern Ocean

Bruce C. Robertson\* & Neil J. Gemmell

School of Biological Sciences, University of Canterbury, Private Bag 4800,  
Christchurch, New Zealand.



# South Georgia Island, Arctic Ocean



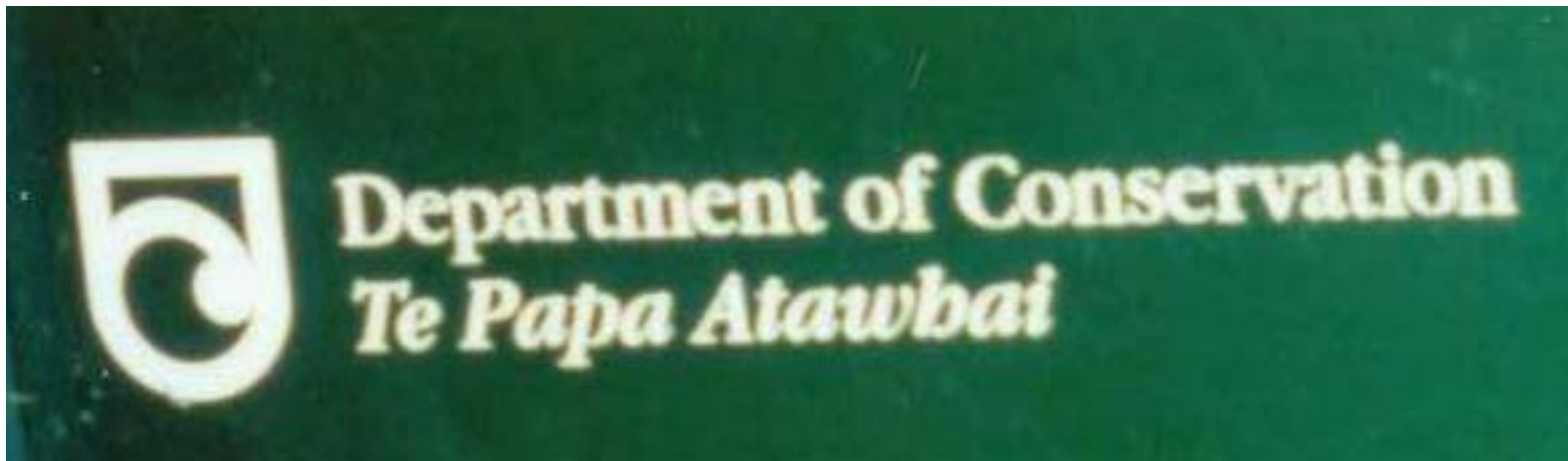
# **RODENT PROOF ROOM**

**Close doors before  
unpacking containers**

# **Biggest successes – rat eradications**

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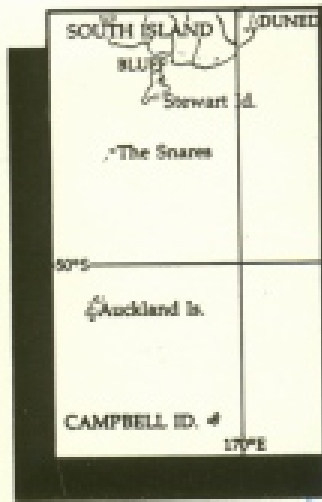
- **Since 1985, central to DoC management**
- **Mammals eradicated from islands of more than 10,000 hectares**
- **Creates refuges for rare species**



*Pete McClelland*  
• PETE McCLELLAND • Campbell Island  
55°30'S - 169°09'E



Campbell Island  
11,300 hectares



Locus	°C	Hestesletten			Greene Peninsula			F <sub>ST</sub>
		(n = 40)			(n = 40)			
		A <sub>N</sub>	H <sub>O</sub>	F <sub>IS</sub>	A <sub>N</sub>	H <sub>O</sub>	F <sub>IS</sub>	
D2Rat185	60	3	0.25	0.28	3	0.5	-0.25	0.03
D3Rat183	63	4	0.65	0.12	3	0.6	0.06	0.04*
D4Rat24	60	4	0.35	0.29	2	0.18	-0.08	0.09*
D5Rat33	60	3	0.59	0.12	5	0.4	0.32	0.05
D6Rat105	63	4	0.7	0.03	5	0.53	0.23	0.14*
D7Rat97	60	2	0.34	0.2	3	0.61	-0.09	0.02*
D8Rat123	60	2	0.4	-0.13	4	0.53	0.08	0.07*
D9Rat110	60	3	0.48	0.03	2	0.38	-0.03	0.003
D10Rat51	60	3	<b>0.35*</b>	0.41	3	0.53	0.21	0.01
D11Rat50	62	2	0.36	-0.03	1	0.00	—	0.26*
D12Rat38	62	5	0.3	0.47	3	0.28	-0.11	0.12*
D13Rat88	60	4	0.4	0.07	3	0.43	0.03	0.33*
D15Rat77	60	3	0.26	0.15	3	0.54	0.03	0.06*
D16Rat57	63	5	0.55	0.19	3	0.75	-0.25	0.06
D17Rat115	62	6	0.63	0.11	5	0.62	0.16	0.06
D18Rat96	60	3	<b>0.43*</b>	0.22	2	0.03	-0.00	0.55*
D19Rat59	60	2	0.35	0.21	2	0.36	0.20	-0.02
D20Rat46	60	3	0.78	-0.16	3	0.43	0.08	0.19*
<b>Average</b>		<b>3.39</b>	<b>0.45</b>	<b>0.14</b>	<b>3.06</b>	<b>0.43</b>	<b>0.06</b>	<b>0.12</b>

